SPACE POWER SYMPOSIUM (C3)
Wireless Power Transmission Technologies, Experiments and Demonstrations (2)

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WIRELESS POWER AND DATA TRANSFER THROUGH METALLIC BIO-CONTAINMENT METAL VESSELS FOR THE MARS SAMPLE RETURN MISSION

Abstract

Mars Sample Return (MSR) Mission foreseen in the 2020s envisages the collection of some tens of samples of Martian soil for return to Earth. Once collected, each sample will be stored and capped into dedicated vessels and finally fixed into a dedicated Container - Orbiting Sample (OS). After the storage of all samples the OS will be launched in Mars orbit and then transferred and sealed into a Bio-Containment system for final storage into the Earth Re-entry Capsule (ERC) for the return trip to Earth.

The Bio-Containment system is composed by a double vessel structure (the innermost in aluminium, the outermost in titanium), each with a closing lid equipped by a triple gasket barrier. The volume between the two vessels will be pressurized with argon gas. Such a system shall provide structural and biological containment throughout all the return trip phases. Along the whole return trip the pressure and temperature evolution will be monitored in order to keep a continuous control on structural integrity and correct containment. To this purpose an appropriate number of pressure and temperature sensors with the associated drive and control electronics, are located in the inter-vessels chamber and activated and read out on a periodic basis.

In order to guarantee the outstanding level of biological protection and structural robustness, the outer vessel will be equipped with a wireless interface capable to operate across the metallic structure of the vessel itself (a titanium shell of thickness of approximately 1 mm) without the need of feed-throughs. Power transfer is realized from external to internal in order to charge the internal batteries and super capacitors, data transfer is realized from internal to external in order to transmit the pressure and temperature information to the avionics of the ERC and then to ground.

The inward power transfer is achieved with a carrier in the 20-50 kHz range while the outward data transfer is achieved via a OOK (On-Off Keying) type modulation.

In the proposed paper the main features of the power and data wireless transfer interface will be described together with the main characteristics of the relevant electronics. The power transfer efficiency versus the metal layer and carrier frequency and the data transfer characteristics versus the needed power, the modulation technique and associated BER (Bit Error Rate) will be addressed

The developed Breadboard and the relevant achieved results will also be presented.